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Patent- og Varemærkestyrelsen
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Pia Høybye-Olsen

PATENT- OG VAREMÆRKESTYRELSEN

Jet spray tool

FIELD OF THE INVENTION

The present invention relates to a jet spray tool for treating surfaces, especially cleaning surfaces using a carbon dioxide snow stream.

BACKGROUND OF THE INVENTION

Carbon dioxide snow jets or jets of pellets are known as cleaning means for surfaces, for example before further surface treatment. For example, such a system is disclosed in International patent application WO 01/76778 by Nielsen.

In International patent application WO 00/74897 by Werner and Zorn, a jet spray tool with a concentric dual nozzle system is disclosed. The dual nozzle system produces a supersonic stream of support gas for the ejected carbon dioxide snow. This system is complicated and expensive to produce.

DESCRIPTION / SUMMARY OF THE INVENTION

It is therefore the object of the invention to provide a novel jet spray tool which is easy and cheap to produce and yet reliable to use.

This object is achieved by a jet spray tool for carbon dioxide snow comprising a jet nozzle connected to a carbon dioxide gas supply and comprising a precooling arrangement for precooling the jet nozzle before ejection of a jet of carbon dioxide snow from the nozzle.

In order to understand the necessity of a precooling arrangement, the following arguments should be observed. When using nozzles of a simple kind, it has been observed that production of carbon dioxide snow in many cases fails during the first few seconds of ejection through the nozzle, unless the nozzle is connected close to the carbon dioxide gas supply. However, in many cases, it is desired to have a carbon dioxide

spray jet several meters away from the carbon dioxide storage tank. If the nozzle arrangement is located several meters from the carbon dioxide supply and connected to the supply via tubing, it has been observed that it takes a substantial length of time, for example between 5 and 10 seconds, before a carbon dioxide jet spray is formed. This is a disadvantage if sequential jet spraying is desired, for example for a cleaning sequence in batch processing, where a jet is desired every 5 second and lasting for 2 seconds. Furthermore, it has been observed during the experiments that the time lapse form the start of carbon dioxide supply to the nozzle and until the start of the jet depends on the moisture content in the air surrounding the nozzle. If the moisture content is high, a jet of snow from water may be formed initially such that it is hard to determine, when the cleaning carbon dioxide jet actually starts working. Therefore, such systems have not with satisfaction been used for sequential processes as described above.

Therefore, substantial experimental work has been performed in connection with the invention in order to find a solution for this kind of problem. It has been found that it is possible to use nozzles of very simple construction with a satisfactory carbon dioxide snow production, if the nozzle is precooled before use for carbon dioxide snow production.

Such a precooling can be accomplished by, for instance, by a Peltier cooling element in thermal contact with the nozzle or by a container with liquid Helium in thermal contact with at least part of the nozzle. In this case, the nozzle can be precooled to a temperature of at least below ÷40°C and preferably to the boiling temperature of liquid carbon dioxide.

The preferred solution is in its nature very simple, cheap and easy to accomplish. In this case, the precooling arrangement comprises an intermediate chamber between the carbon dioxide supply and the nozzle and a valve between the intermediate chamber and the nozzle. The intermediate chamber is located close to the nozzle and the intermediate chamber is configured to be filled with carbon dioxide gas for rapid supply of carbon dioxide gas to the nozzle upon opening of the valve. Thus, the intermediate

chamber functions as a buffer for rapid carbon dioxide gas supply. A typical internal volume of the intermediate chamber is between 0.05 and 10 decilitre dependent on the size of the desired jet.

The surprising finding that a satisfactory snow jet can be produced with even very simply constructed nozzles is believed to be due to the fact that the rapid transport of gas from the intermediate chamber to the nozzle cools the nozzle so fast and efficient that a jet can be formed within less than a second after opening of the valve. Therefore, this system is easy to construct, cheap to produce and yet very reliable and precise.

It may in some circumstances be an advantage that the intermediate chamber and the gas therein are cooled during the storage time, which in most circumstances is relatively short. For this cooling, the intermediate chamber has an opening into atmosphere for exhaust of carbon dioxide, which causes cooling.

SHORT DESCRIPTION OF THE DRAWINGS

The invention will be explained in more detail with reference to the drawing, where

FIG. 1 is a diagram of the jet spray system with the spray tool,

FIG. 2 is a sketch of a possible embodiment of the nozzle.

DETAILED DESCRIPTION / PREFERRED EMBODIMENT

Fig. 1 is a diagram of the jet spray system with a jet spray tool according to the invention. The jet spray system 1 comprises a storage tank 2 for carbon dioxide gas. The storage tank 2 is connected to a nozzle arrangement 9 with a nozzle 10, through which a jet carbon dioxide snow 11 is ejected. The connection 4, 6, 8 between the storage tank 2 and the nozzle 10 can be accomplished by stiff and/or flexible tubing that generally is used for this kind of arrangements. The carbon dioxide supply from the storage tank can be controlled by a valve 3. Inserted between the storage tank 2 and the nozzle 10 is an intermediate chamber 5, where carbon dioxide supplied from the stor-

age tank 2 can be stored for rapid extraction. This carbon dioxide gas can be supplied to the nozzle, when valve 7 is opened. The supply to the nozzle from the intermediate chamber 5 is rapid enough to cause a fast cooling of the nozzle resulting in a formation of a snow jet tool after a short initial phase of cooling, the phase typically being less than a second, which is very suited for sequential spraying with time scales in the order of few seconds. Typically, the intermediate chamber 5 is located within one or two meter from the nozzle.

The nozzle arrangement 9 that can be used a system according to the invention is illustrated in Fig. 2. The nozzle arrangement 9 is connected to the tubing 8 by a standard connection, for example a threaded fitting 13. The nozzle arrangement 9 comprises a tubular nozzle 10 with a simple jet exit hole 16 inserted into a nozzle holder 14 fastened to the tube fitting 13. This nozzle arrangement 9 with the nozzle 10 is very simple in nature, though still providing a satisfactory jet 11 of carbon dioxide snow

An improvement of the jet formation has been observed for nozzles 10 that are provided with a lateral groove 15 across the front end of the nozzle 10 with the ejection hole 16, which is shown in an enlarged head-on perspective in Fig. 2b.

According to the invention, a cheap and simple arrangement has been provided for reliable carbon dioxide snow formation. The arrangement according to the invention is furthermore suited for installation in already existing machines using carbon dioxide snow jets for cleaning.

CLAIMS

1. Jet spray tool for carbon dioxide snow comprising a jet nozzle connected to a carbon dioxide supply and comprising a precooling arrangement for precooling the jet nozzle before ejection of a jet of carbon dioxide snow from the nozzle.

2. Jet spray tool according to claim 1, wherein the precooling arrangement is configured to precool the nozzle to a temperature of at least the boiling temperature of liquid carbon dioxide.

3. Jet spray tool according to claim 2, wherein the precooling arrangement comprises a intermediate chamber between the carbon dioxide supply and the nozzle and a valve between the intermediate chamber and the nozzle, where the intermediate chamber is located close to the nozzle and the intermediate chamber is configured to be filled with carbon dioxide for rapid supply of carbon dioxide gas to the nozzle upon opening of the valve.

4. Jet spray tool according to claim 3, wherein the internal volume of the intermediate chamber is of the order of between 0.05 and 10 decilitre.

5. Jet spray tool according to claim 3 or 4, wherein the intermediate chamber has an opening into atmosphere for evaporation of carbon dioxide.

6. Jet spray tool according to claim 2, wherein the precooling arrangement comprises a Peltier element in thermal contact with the nozzle.

7. Jet spray tool according to claim 2, wherein the precooling arrangement comprises a container with liquid Helium in thermal contact with at least part of the nozzle.

8. Jet spray tool according to anyone of the preceding claims, wherein the nozzle is tubular and comprises a lateral groove across the exit hole at the front end of the nozzle.

Abstract

Jet spray tool

Jet spray tool for carbon dioxide snow comprising a jet nozzle connected to a carbon dioxide supply and comprising a precooling arrangement for precooling the jet nozzle before ejection of a jet of carbon dioxide snow from the nozzle. Preferably, the precooling arrangement comprises a intermediate chamber between the carbon dioxide supply and the nozzle and a valve between the intermediate chamber and the nozzle, where the intermediate chamber is located close to the nozzle and the intermediate chamber is configured to be filled with carbon dioxide for rapid supply of carbon dioxide gas to the nozzle upon opening of the valve.

(FIG. 1)

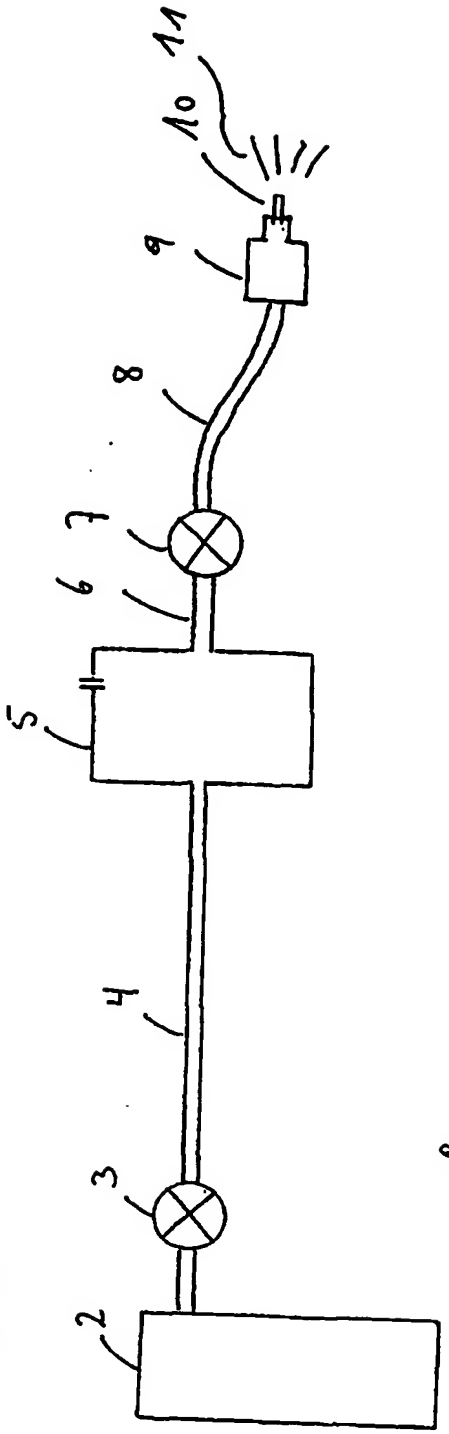

FIG. 1

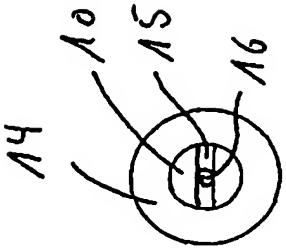

FIG. 2b

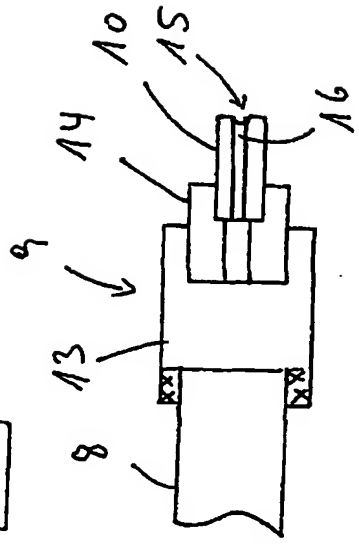

FIG. 2a